C_3F_8 fill procedure

This procedure covers filling of the bubble chamber inner vessel with its nominal charge of C_3F_8. Obviously there is plenty of hazards and risk here, hence this is a written procedure.

1) Review procedure 4 "C3F8 Handling Procedure". THIS HAS NOT BEEN WRITTEN

2) Ensure that the hydraulic system is filled and appropriately initialized. It should be under neutral pressure, with the inner vessel at a slightly expanded bellows position. The bubble chamber should be completely filled with water, all the way up to the fill and bleed valves. All valves should be closed.

3) Start the "Commissioning Tool" VI and initiate data logging every 5 seconds.

4) Initiate cool-down[1] to just above 0°C. This will take a while. Follow procedure 6.2 Bubble Chamber Temperature Ramp up/down until an appropriate temperature has been achieved and stabilized. If the NESLAB bath contains only water, set it to maintain a bath temperature no lower than 2°C.

5) Assemble the C_3F_8 transfer lines, vacuum pump, transfer cart, C_3F_8 transfer bottle, and C_3F_8 sample bottle. The plumbing consists of a flexible connection from the C_3F_8 transfer bottle to the sample bottle. The line is equipped with a tee to a vacuum gauge, an isolation valve, and a vacuum pump. The pump down port should be near the sample bottle. The cart is equipped with an electronic balance. The C_3F_8 transfer bottle sits on the balance. Position the transfer line so that any condensed C_3F_8 flows into the sample bottle. Zero the balance. Place the sample bottle in an ice-water bath.

6) Ensure MV-011 and the transfer bottle valve are closed. Open the plumbing to the vacuum pump and evacuate the C_3F_8 transfer line. Once it is evacuated, open the valve to the empty sample bottle and evacuate it. The isolate and turn off the vacuum pump. Record the vacuum pressure, wait 5 minutes, and re-check the vacuum pressure to ensure there are no leaks.

7) Record the mass of the transfer bottle and of the sample bottle.

8) Follow the "Before Handling C_3F_8" section of procedure 4. NOT WRITTEN

[1] The actual temperature is not critical. It needs to be cool enough to maintain the distillation relative to the ~20°C reservoir temperature.

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9) Open the transfer bottle and condense some C_3F_8 into the sample bottle for 5 minutes, or until 50g has been transferred.

10) Close the valves to both bottles and rerecord the mass of the transfer bottle.

11) While facing away from the gas stream, vent the transfer line through the pump down port.

12) Disconnect the sample bottle and connect the transfer line to the bubble chamber main fill valve (MV-011).

13) Ensure MV-011 and the transfer bottle valve are closed. Open the plumbing to the vacuum pump and evacuate the C_3F_8 transfer line. Once that is evacuated, isolate and turn off the vacuum pump. Record the vacuum pressure, wait 5 minutes, and re-check the vacuum pressure to ensure there are no leaks.

14) Open MV-011 and ensure that the vacuum does not rise significantly above the vapour pressure of water. If it does, it indicates that gas has entered the inner vessel. Close MV-011.

15) Compress (slightly) the chamber. Be very careful not to generate a pressure more than a few psi. It is only necessary to take the slack out of the system so that the bellows do not overextend when the inner vessel is pressurized with C_3F_8 gas.

16) Verify that the vacuum pump is isolated and MV-011 is closed, then slowly open the valve to the C_3F_8 tank to pressurize the lines. The line pressure should rise to approximately 115psi.

17) Begin the distillation by opening MV-011. Open MV-012 slightly, such that water leaks slowly from the bleed line, but does not allow C_3F_8 to boil out. The goal is to keep chamber pressure high enough to prevent C_3F_8 from boiling, so that it condenses in the fill line and settles to the bottom of the chamber while only water is displaced through MV-012. This will require delicate modulation of MV-012. There should be a large pressure differential across MV-012.

18) Once a valve position has been established that allows continuous and steady distillation of C_3F_8, allow distillation to proceed until the desired mass of C_3F_8 has been transferred from the vessel into the chamber. Over time, C_3F_8 should be observed forming a puddle in the bottom of the vessel. The mass in the C_3F_8 tank should continually decrease. This may take a long time.

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19) Cross-check the mass transfer data, the C_3F_8 level in the vessel, and the quantity of water removed from the vessel. Make sure the appropriate amount of fluid has been transferred.

20) Isolate the C_3F_8 transfer bottle.

21) Wait for the overpressure of C_3F_8 in the transfer line to condense. When the pressure is minimized, close MV-011 and isolate the transfer line.

22) Vent the transfer line and disconnect it from both the inner vessel and the transfer bottle. Cap the transfer bottle and the inner vessel port.

23) Ensure the "After Handling C_3F_8" section of procedure 3 was followed.

24) Slowly charge the hydraulic system. Once you've established that the inner vessel is "floating" (i.e. that when all of the C_3F_8 is condensed the bellows is off its stop) the pressure can be run up to the nominal 200 psig.

25) Initiate warm up of the chamber to its operating point following procedure 2.5 "Bubble Chamber Temperature Ramp up/down".

26) Terminate data acquisition and backup the data by rsync'ing with the coupp2ls1 data disk.